**Original Article**

***http://wjpn.ssu.ac.ir***

# Incidence and Types of Congenital Anomalies in Newborns of Yazd Hospitals during Six Years (2016- 2021) Based on National Mother and Newborn Health Registration System

Elahe Dadbinpour[1], Ali Dadbinpour[2,3], Sedigheh Ekraminasab[4,5], Fatemeh Ghasemi[6], Haniyeh Nikkhah[2], Shiva Rafati[1*], Mahta Mazaheri[2,4*]

[1] Department of Medical Ethics and Pediatrics, Faculty of Medicine, Shahed University, Tehran, Iran
[2] Department of Medical Genetics, School of Medicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
[3] Genetic and Environmental Adventures Research Center, School of Abarkouh Paramedicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
[4] Mother and Newborn Health Research Center, Shahid Sadoughi Hospital, School of Medicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
[5] Department of Hematology and Blood Banking, School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[6] Department of Midwifery, School of Medicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

**Received:** 10 July 2023 **Revised:** 04 September 2023 **Accepted:** 15 October 2023

## ARTICLE INFO

**Corresponding authors:**
Shiva Rafati
Mahta Mazaheri

**Email:**
dr.shrafati@yahoo.com
mazaheri54@yahoo.com

**Keywords:**
Incidence;
Iran;
Congenital;
Newborn;
Heart Defects;
Genitalia

## ABSTRACT

**Background:** Congenital anomalies are responsible for a remarkable proportion of disability and mortality in newborns. Therefore, the aim of this study is to investigate the incidence and types of congenital anomalies in newborns born in Yazd hospitals during the years 2016 to 2021.

**Methods:** In this cross-sectional descriptive study, the data of all live births from 2016 to 2021 in hospitals of Yazd were extracted from the database of the National Mother and Newborn Health Registration System of Shahid Sadoughi University of Medical Sciences.

**Results:** From a total of 151,566 live births during six years, congenital anomalies were seen in 1338 (0.88%) newborns. The most common congenital anomalies involved the cardiovascular system (0.31%), followed by musculoskeletal anomalies (0.16%), gastrointestinal tract (0.14%), and genital system (0.1%), respectively. The incidence increased from 0.63% in 2016 to 1.05% in 2021, with the highest incidence observed in 2020 (1.31%).

**Conclusion:** The incidence of congenital anomalies in Yazd is lower than in most studies in Iran. However, shows an increasing trend over the years which can be due to the improvement of diagnostic methods especially in the case of congenital heart anomalies. However, more extensive studies on maternal risk factors and neonatal outcomes are needed.

## Introduction

A congenital anomalies, commonly called a birth defect, is a structural or functional abnormality that appears at birth.[1] Congenital anomalies are the main cause of disability and death in children in developing and developed countries. Hospitalization and treatment costs of these children place a heavy burden on the health system and their families.[2,3] As defined by the World Health Organization (WHO), the term congenital anomalies includes any functional, morphological, molecular, or biochemical defect that may occur in the embryo and fetus.[4] This pathology is a topic covered in the ICD-10-CM (Q00-Q99).[5,6] According to the WHO, these anomalies may include single or several defects that can be recognized and identified at birth.[3] The cause of anomalies in about 50% of cases is unidentifiable (idiopathic).[7] Anomalies which affect an neonate's health status, life expectancy, physical or social functioning may be described as "major" anomalies. In contrast, "minor" anomalies are those with little or no impact on health or short-term or long-term function.[8]

Studies conducted in different parts of the world show that the incidence of congenital anomalies varies in different countries.[9] The WHO reports that approximately 303,000 newborns worldwide die within 30 days of birth each year due to congenital anomalies.[10] Most of these anomalies occur in middle and low-income countries.[11,12] The incidence of birth defects varies among different ethnic groups. For example, the incidence of anomalies is estimated 8.7% in the United Kingdom and 2.76% in the United States.[13] In Iran, studies have shown that the overall incidence of anomalies is 2.6%, so that boys and girls are 2.8% and 2%, respectively.[14] Also, according to the Irani meta-analysis, the highest incidence of anomalies is related to the musculoskeletal system (29.1%), and the lowest is related to the respiratory system (2.9%).[15]

Factors that may increase the risk of congenital anomalies include genetic disorders, demographic characteristics, socioeconomic factors, nutritional factors including maternal obesity, use of certain medications, infections during pregnancy, chemicals, ionizing radiation, and air pollution.[16] In addition, some severe congenital anomalies cause miscarriage or intrauterine death of the fetus.[3] Despite the progress that has been made in the field of etiology and pathogenesis of anomalies, 22% of infant deaths are caused by major congenital anomalies.[14] Congenital anomalies have been described in about 3% of live births and 20% of stillbirths in industrialized countries[17] and the cost of health care for them is more than 6 million per year.[14] This study was conducted to estimate the frequency of congenital malformations in newborns in Yazd City. Considering the importance of anomalies for society and families of newborns, more research is needed to reduce the incidence of anomalies and control risk factors.

## Materials and Methods

***Study design:*** This cross-sectional and retrospective descriptive study was conducted to investigate the incidence and types of congenital anomalies in newborns in Yazd from 2016 to 2021. In this cross-sectional study, the characteristics of all infants diagnosed by a pediatrician and registered in the National Mother and Newborn Health Registration System of Shahid Sadoughi University of Medical Sciences, Yazd, were investigated. The registration systems include https://qlik-view.health.gov.ir and https://qlik-view.health.gov.ir. The data was extracted from the system and entered into the information form. Then, the required information, including the characteristics of the mother (age, birth frequency, and education) and the newborns (birth weight, gender, and clinical outcome), as well as information related to pregnancy (gestational age and delivery method), were extracted

from the newborn file and recorded in an information form. The type of congenital malformations was also determined based on the diagnostic standard of the International Classification of Diseases (ICD-10) for congenital anomalies.

***Study population:*** The population investigated in this research includes all newborns born between 2016 and 2021 in hospitals in Yazd province. The information registration system was completed based on a standard questionnaire and registered in the system by trained experts. Cases whose file information was incomplete were excluded from the study. Based on this, a total of 151566 neonates born in this period were examined.

***Statistical analysis:*** For the statistical analysis of the information, the study data from the information form was entered into the statistical software SPSS version 21 (version 21, IBM Corporation, Armonk, NY). Qualitative data were reported as frequency and percentage, and quantitative data were reported as mean ± standard deviation (SD).

## Results

***Characteristics of mothers and neonates:*** Table 1 shows the main characteristic of neonates and mothers. These neonates included 51.6 % males and 48.23 % females. The birth weight of 85.1% of these neonates was normal and between 2500-4000 gr. Also, 13.2 % of them had low birth weight. Mother's age during pregnancy was normally distributed and 82.77% of them were between 18 and 35 years old and 15.85% were over 35 years old. The gestational age of 90.75 % of the neonates was between 37 and 41 weeks. Also, 64.19% of the mothers had between 2 and 4 childbirths.

***Incidence of types and subtypes of congenital anomalies:*** During the six years (2016-2021), a total of 151,566 live births were delivered in Yazd hospitals and a total of 1338 neonates with congenital anomalies were registered. The total number of cases of live births as well as the incidence of each type of congenital anomaly from 2016 to 2021 is reported in Table 2.

**Table 1.** Characteristics of Mothers and Neonates

| | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | Percent |
|---|---|---|---|---|---|---|---|
| Gender | | | | | | | |
| Male | 51.45% | 51.62 % | 51.41 % | 51.51 % | 52.12 % | 51.9 % | 51.6 % |
| Female | 48.48 % | 48.27 % | 48.54 % | 48.49 % | 47.6 % | 48 % | 48.23 % |
| Ambiguous | 0.07 % | 0.10 % | 0.05 % | 0.08 % | 0.10 % | 0.10 % | 0.08 % |
| Weight (gr) | | | | | | | |
| ≤ 750 | 0.79 % | 0.63 % | 0.9 % | 0.68 % | 0.87 % | 0.75 % | 0.77 % |
| 750- 1000 | 0.28 % | 0.29 % | 0.32 % | 0.29 % | 0.69 % | 0.58 % | 0.40 % |
| 1000- 1500 | 0.69 % | 0.67 % | 0.73 % | 0.82 % | 4.08 % | 1.85 % | 1.47 % |
| 1500- 2500 | 7.32 % | 6.79 % | 7.46 % | 8.5 % | 23.81 % | 9.23 % | 10.5 % |
| 2500-4000 | 88.8 % | 89.46 % | 88.62 % | 89 % | 69 % | 85.72 % | 85.1 % |
| ≥ 4000 | 2.04 % | 2.17 % | 1.95 % | 0.63 % | 1.61 % | 1.87 % | 1.7 % |
| Age of mother (year) | | | | | | | |
| ≤ 18 | 1.48 % | 0.63 % | 1.38 % | 1.29 % | 1.08 % | 0.97 % | 1.13 % |
| 18-35 | 85.37 % | 85.58 % | 84.84 % | 78.98 % | 81.69 % | 80.18 % | 82.77 % |
| ≥ 35 | 12.15 % | 13.8 % | 13.78 % | 19.33 % | 17.23 % | 18.85 % | 15.85 % |
| Age of gestation (weeks) | | | | | | | |
| ≤ 36 | 7.56 % | 7.92 % | 6.60 % | 7.63 % | 10.5 % | 14.14 % | 9.05 % |
| 37- 41 | 91.97 % | 91.88 % | 93.14 % | 92.04 % | 89.75 % | 85.73 % | 90.75 % |
| ≥ 41 | 0.47 % | 0.20 % | 0.26 % | 0.33 % | 0.20 % | 0.13 % | 0.26 % |
| Number of births | | | | | | | |
| 1 | 30.44 % | 33.59 % | 27.78 % | 30.45 % | 29.32 % | 31.1 % | 30.44 % |
| 2- 4 | 64.50 % | 65.34 % | 65.62 % | 64.88 % | 62.28 % | 62.56 % | 64.19 % |
| ≥ 4 | 5.06 % | 1.08 % | 6.6 % | 4.67 % | 8.41 % | 6.34 % | 5.36 % |
| Type of delivery | | | | | | | |
| Vaginal | 51.28 % | 49.53 % | 48.73 % | 47.75 % | 46.10 % | 45.89 % | 48.21 % |
| Cesarean | 48.72 % | 50.47 % | 51.27 % | 52.25 % | 53.90 % | 54.11 % | 51.78 % |

**Table 2.** Incidence of Congenital Anomalies by Type

| | 2016 (n = 28659) | 2017 (n = 27648) | 2018 (n = 26678) | 2019 (n = 23644) | 2020 (n = 21882) | 2021 (n = 23055) | Total (n = 151566) |
|---|---|---|---|---|---|---|---|
| Anomalies | | | | | | | |
| Nervous system | 8 (0.03%) | 17 (0.06%) | 26 (0.09%) | 20 (0.08%) | 22 (0.1%) | 35 (0.15%) | 128 (0.084%) |
| Cardiovascular | 7 (0.024%) | 10 (0.04%) | 91 (0.34%) | 83 (0.35%) | 165 (0.75%) | 127 (0.55%) | 483 (0.31%) |
| Respiratory | 1 (0.0003%) | 2 (0.007%) | 19 (0.07%) | 7 (0.03%) | 7 (0.03%) | 14 (0.06%) | 50 (0.03%) |
| Gastrointestinal | 6 (0.02%) | 18 (0.065%) | 40 (0.15%) | 17 (0.07%) | 55 (0.25%) | 82 (0.35%) | 218 (0.14%) |
| Urinary-genital | 25 (0.09%) | 38 (0.14%) | 27 (0.1%) | 7 (0.03%) | 31 (0.14%) | 27 (0.12%) | 155 (0.1%) |
| Musculoskeletal | 43 (0.15%) | 91 (0.33%) | 27 (0.1%) | 13 (0.05%) | 26 (0.11%) | 43 (0.18%) | 243 (0.16%) |
| Skin | 3 (0.01%) | 6 (0.021%) | 6 (0.02%) | 0 (0%) | 3 (0.01%) | 6 (0.03%) | 24 (0.015%) |
| Head and neck | 4 (0.014%) | 31 (0.11%) | 16 (0.06%) | 10 (0.042%) | 12 (0.05%) | 10 (0.04%) | 83 (0.05%) |
| Chromosomal | 5 (0.02%) | 24 (0.086%) | 10 (0.04%) | 9 (0.04%) | 16 (0.07%) | 0 (0%) | 64 (0.04%) |
| Other | 78 (0.3%) | 0 (0%) | 11 (0.041%) | 28 (0.12%) | 17 (0.08%) | 20 (0.09%) | 154 (0.1%) |
| Total anomalies | 180 (0.63%) | 237 (0.86%) | 233 (0.87%) | 157 (0.66%) | 288 (1.31%) | 243 (1.05%) | 1338 (0.88%) |

The overall incidence of congenital anomalies was 0.88%. According to the findings of our study, the incidence of congenital anomalies has increased from 0.63% in 2016 to 1.05% in 2021. The highest incidence of observed congenital Anomalies is related to the cardiovascular system, which constitutes about 0.31% of cases. After the cardiovascular system, the highest amount of abnormality was observed in the musculoskeletal (243 [0.16%]), gastrointestinal tract (218 [0.14%]), and genitourinary system (155 [0.1%]), respectively. The frequency of chromosomal anomalies during the years of conducting this study was 4.78% of all anomalies (64 [0.04%]), with a frequency of 0.4 per 1000 live births. In 2021, no case of chromosomal anomalies was reported in the National Maternal and Newborn Health Registration System. The lowest rate of abnormality was in the respiratory system (50 [0.03%]) and the skin (24 [0.015%]).

The incidence of subtypes of congenital anomalies is reported in Table 3. Among subtypes of anomalies, atrial septal defect (ASD) was the most common anomaly diagnosed with a number of 122 (45.2%) from 2018 to 2021. The esophageal atresia (45 [34.1%]) was the most common abnormality observed in the gastrointestinal system. The most common musculoskeletal abnormality observed in the present study was Clubfoot (32 [50%]).

**Table 3.** Incidence of Subtypes of Congenital Anomalies in Yazd (2018- 2021)

| Anomalies | Number | % |
|---|---|---|
| Nervous system | | |
| Hydrocephalus | 22 | 36.7 |
| Anencephaly | 4 | 6.7 |
| Microcephaly | 20 | 33.3 |
| Myelomeningocele | 3 | 5 |
| Spina-bifida | 4 | 6.7 |
| Holoprosencephaly | 3 | 5 |
| Encephalocele | 3 | 5 |
| Dandy Walker syndrome | 1 | 1.6 |
| Total | 60 | 100% |
| Head and neck | | |
| Cleft lip and palate | 18 | 78.3 |
| Anotia | 1 | 4.3 |
| Microphtalmos | 0 | 0 |
| Anophthalmia | 1 | 4.3 |
| Microtia | 1 | 4.3 |
| Congenital glaucoma | 2 | 8.8 |
| Total | 23 | 100 |

**Table 3.** Incidence of Subtypes of Congenital Anomalies in Yazd (2018- 2021) (Continues)

| Anomalies | Number | % |
|---|---|---|
| Cardiovascular system | | |
| Atrial septal defect (ASD) | 122 | 45.2 |
| Ventricular septal defect (VSD) | 45 | 16.7 |
| Coarctation aorta | 22 | 8.2 |
| Multiple congenital cardiac anomalies | 7 | 2.6 |
| Pulmonary stenosis | 15 | 5.6 |
| Transposition of the great arteries | 3 | 1.1 |
| Tetralogy of Fallot | 5 | 1.9 |
| Hypoplastic Left Heart | 12 | 4.4 |
| Aortic stenosis | 24 | 8.8 |
| Single ventricle defect | 6 | 2.2 |
| Truncus arteriosus | 9 | 3.3 |
| Total | 270 | 100 |
| Gastrointestinal system | | |
| Atresia of the small intestine | 36 | 27.3 |
| Esophageal atresia | 45 | 34.1 |
| Anorectal atresia | 22 | 16.7 |
| Omphalocele | 10 | 7.6 |
| Gastroschisis | 4 | 3 |
| Hirschsprung | 14 | 10.6 |
| Malrotation | 1 | 0.7 |
| Total | 132 | 100 |
| Genitourinary system | | |
| Hypospadias | 7 | 11 |
| Hydronephrosis | 17 | 26.6 |
| The testicle has not descended | 18 | 28.1 |
| Epispadias | 1 | 1.5 |
| Multicystic kidney | 6 | 9.4 |
| Renal agenesis | 3 | 4.7 |
| Sexual ambiguity | 8 | 12.5 |
| Posterior urethral valve (PUV) | 2 | 3.1 |
| Exstrophy of the bladder | 2 | 3.1 |
| Total | 64 | 100 |
| Musculoskeletal system | | |
| Clubfoot | 32 | 50 |
| Polydactyly | 13 | 20.3 |
| Syndactyly | 4 | 6.25 |
| Osteogenesis imperfecta | 6 | 9.4 |
| Achondroplasia | 4 | 6.25 |
| Amputation | 5 | 7.8 |
| Total | 64 | 100 |
| Chromosomal | | |
| Trisomy 21 | 11 | 47.8 |
| Trisomy 18 | 6 | 26.1 |
| Trisomy 13 | 1 | 4.3 |
| Pierre robin | 5 | 21.8 |
| Turner syndrome | 0 | 0 |
| Total | 23 | 100 |

## Discussion

Congenital malinformations or birth defects are defined as a chromosomal anomalies or structural with a significant effect on the health and development of a child and determine its further contribution to social life.[6] Congenital anomalies are one of the

causes of disability in developed and developing countries. Therefore, systematic collection and analysis of birth defects data using the birth defects registration system are very necessary for health and treatment planning and prevention services. Therefore, in this retrospective cross-sectional study, the frequency of cases of congenital anomalies at birth and their types during the years 2016 to 2021 were investigated in infants born in hospitals in Yazd province. We previously evaluated Gestational diabetes mellitus (GDM)[18] and the positive predictive value of screening tests among women in Yazd.[19,20] Based on the findings of the present research, by examining 151,566 live births from 2016 to 2021, the incidence of cases of congenital anomalies in the investigated period was 0.88%. The frequency of cases of congenital anomalies reported in different cities of Iran and other countries of the world has been very variable. Abnormality incidence rates are usually a function of case definition and inclusion criteria.

Studies that investigated the frequency of congenital anomalies in Iran reported a Wide range from 0.75% to 16.6%. Two meta-analyses estimated the incidence of congenital anomalies in Iran, Daliri et al., in 2018 and Vatankhah et al., in 2017 reported the incidence of congenital anomalies as 1.8% and 2.3%, respectively.[21,3] The studies that had the closest results to us were the studies of Aali Jahan and Davari. In the studies conducted by Aali Jahan et al., in Ardabil and Davari et al., in Isfahan, the frequency of congenital anomalies at birth was 0.82% and 0.75%, respectively, which is close to the results of our study.[2,22] This is despite the fact that most of the studies conducted in Iran have reported a higher frequency of congenital anomalies. The highest incidence of congenital anomaly was reported 16.6% in Mohseni study. Mohseni et al. examined the incidence of fetal defects and related factors in neonates born and hospitalized in Kerman Hospital. In their study, the incidence of congenital anomalies in neonates was reported 16.6%.[14] Rostamizadeh et al. evaluated alteration in the incidence and pattern of congenital anomalies among newborns during one decade in Azarshahr, Northwest of Iran. Their findings showed the incidence of congenital anomalies in newborns during the period from 2002-2003 and 2012-2013 was 1.31% and 1.06 respectively. Also, the incidence and pattern of congenital anomalies have changed over one decade. [7]

In this study, the most common congenital anomalies were observed in cardiovascular 483 (0.31%). Also, ASD was the most common subtype of anomalies. In Mohseni et al. study, the most common anomalies included cardiovascular anomalies and genitourinary anomalies.[14] Cardiovascular anomalies are one of the most common congenital anomalies, especially in diabetic mothers, the incidence of Cardiovascular anomalies is increasing with the advancement of diagnostic methods such as fetal echocardiography.[23,24] GDM affecting approximately 7% of pregnant women, is associated with a fivefold increase in the risk of cardiovascular anomalies in their neonates.[25] The overall incidence of GDM in Yazd was 10.93%,[19] so the incidence of cardiovascular anomalies in our study was higher than other studies. After cardiovascular, the most common anomalies were musculoskeletal 243 (0.16%), digestive 218 (0.14%), and urogenital system 155 (0.1%), respectively. Unlike our study, in many studies, the highest frequency of congenital anomalies observed is related to anomalies of the musculoskeletal system, which constitutes about a quarter of the cases. According to an Irani meta-analysis, the highest incidence of anomalies is related to the musculoskeletal system (29.1%) and the lowest is related to the respiratory system (2.9%).[15] In this study, compared to previous studies, the overall incidence of chromosomal abnormality was lower and was around 0.04%, and from around 0.09 in 2017, it reached zero in 2021, which shows that the

screening tests have worked very effectively and this procedure has been successful.

A wide range of factors associated with birth defects including genetics, multifactorial inheritance, micronutrient deficiency, and environmental teratogenic factors have been reported.[26] Considering the higher frequency of stillbirths in female neonates, it seems that the higher incidence of congenital anomalies in male neonates may be because female neonates often suffer from fatal and life-threatening congenital anomalies and therefore disappear before birth and are not accompanied by anomalies. In our study, being a boy was one of the risk factors influencing the incidence of anomalies. Interestingly, in a systematic review from 1986 to 2018 in Iran, Irani et al. reported the incidence of anomalies in girls as 2% and in boys as 2.8%.[15] In other studies, the incidence of defects in boys has been reported more.[14] Of course, some other studies have not reported a relationship between gender and congenital anomalies in neonates, however, different definitions of anomalies in different studies can be the reason for these differences. The association between congenital anomalies with low birth weight and prematurity of the newborn has been well shown in previous studies.[22] The reason for this can be the increased probability of premature birth in neonates with congenital anomalies. Among the important secondary results in this study, we can mention the increasing trend of the average age of mothers, cesarean births, and as a result premature neonates with low birth weight during the years of conducting this study (Table 1). Although the incidence of congenital anomalies was lower than in other regions, there is a need for more extensive studies on accurate estimates as well as risk factors and neonatal outcomes.

***Limitation:*** Finally, as a limitation of this study, it should be noted that the frequency of congenital anomalies reported in the present study is only a partial estimate of the frequency of congenital anomalies because it was only based on the physical examination of newborns and, subsequent anomalies that are diagnosed with age or anomalies which causes death in the fetal period are not counted in these statistics. Another limitation of our work was the lack of accurate reporting of skin abnormalities. Hemangioma, melanosis, milia and sebaceous mole are some of the most common of these diseases. Many of these cases were not reported in our work. Also, some anomalies such as metabolic disorders, severe deafness, and some congenital heart defects, although they may be present at birth, do not become apparent for some time. On the other hand, in the present study, information related to congenital anomalies was extracted from the data of the National Mother and Newborn Health Registration System of Shahid Sadoughi University of Medical Sciences, Yazd. However, it is possible that all anomalies in this system have not been properly identified and recorded. Therefore, attention to the possibility of undercounting should be considered in the analysis of the results that are presented based on the data extracted from the national system. In an optimal congenital anomalies registration system, active surveillance and care should be provided. All neonates should be examined by an experienced and trained doctor familiar with the abnormality registration and coding systems and neonates with anomalies should be identified based on standard instructions.

## Conclusion

According to the results of this study, the incidence of congenital anomalies in newborns between 2016 and 2021 in Yazd province is 0.88%, which is lower than most studies conducted in the country, but it shows an increasing trend during the studied years, which can be due to the improvement of diagnostic methods, especially in the case of congenital heart anomalies. The highest frequency of congenital anomalies was related to the cardiovascular, musculoskeletal, and urinary-genital systems, respectively. Also, the anomalies of respiratory and skin systems were the least frequent. Further studies on maternal risk factors and neonatal outcomes are needed in the future.

## Conflict of Interest

Authors have no conflict of interest.

## Acknowledgments

The authors thank the editors and the anonymous reviewers for insightful suggestions on this study.

## Funding

No funding has been received for this study.

## Ethical Considerations

The present study was approved by Shahed University Ethics Committee (IR.SHAHED.REC.1400.223).

## Author's Contribution

Conceptualization, S.R., M.M. and A.D.; methodology, S.R. and M.M.; formal analysis, E.D. and S.E.; investigation, E.D., A.D., H.N. and F.G.; resources, E.D. and F.G.; data curation, E.D and H.N.; writing—original draft preparation, S.E.; writing—review and editing, S.R., M.M. and A.D.; supervision, M.M. and S.R. All authors have read and agreed to the published version of the manuscript.

**How to Cite:** Dadbinpour E, Dadbinpour A, Ekraminasab S, Ghasemi F, Nikkhah H, Rafati S, et al. Incidence and Types of Congenital Anomalies in Newborns of Yazd Hospitals during Six Years (2016- 2021) Based on National Mother and Newborn Health Registration System. World J Peri & Neonatol 2023; 6(1): 17-25.
DOI: 10.18502/wjpn.v6i1.14249

## References

1. Geneti SA, Dimsu GG, Sori DA, Amente LD, Kurmane ZM. Prevalence and patterns of birth defects among newborns in southwestern Ethiopia : a retrospective study. Pan Afr Med J 2021; 21(40): 248.
2. Alijahan R, Mirzarrahimi M, Ahmadi Hadi P, Hazrati S. Prevalence of congenital abnormalities and its related risk factors in Ardabil, Iran, 2011 [in Persian]. Iran J Obstet Gynecol Infertil 2013; 16(54): 16-25.
3. Vatankhah S, Jalilvand M, Sarkhosh S, Azarmi M, Mohseni M. Prevalence of congenital anomalies in iran: A review article. Iran J Public Health 2017; 46(6): 733-43.
4. Shi Y, Zhang B, Kong F, Li X. Prenatal limb defects: Epidemiologic characteristics and an epidemiologic analysis of risk factors. Medicine (Baltimore) 2018; 97(29): e11471.
5. Wang H, Barisic I, Loane M, Addor MC, Bailey LM, Gatt M, et al. Congenital clubfoot in Europe: A population-based study. Am J Med Genet Part A 2019; 179(4): 595-601.
6. Kozovyi R, Kovalchuk L, Kitsera N. The frequency and spectrum of birth defects among 486 longlivers from Ivano-Frankivsk region (West Ukraine). Trends Med 2020; 20(5): 1-4.
7. Rostamizadeh L, Bahavarnia SR, Gholami R. Alteration in incidence and pattern of congenital anomalies among newborns during one decade in Azarshahr, Northwest of Iran. Int J Epidemiol Res 2017; 4(1): 37-43.
8. DeSilva M, Munoz FM, Mcmillan M, Kawai AT, Marshall H, Macartney KK, et al. Congenital anomalies: Case definition and guidelines for data collection, analysis, and presentation of immunization safety data. Vaccine 2016; 34(49): 6015-26.
9. Shawky RM, Sadik DI. Congenital malformations prevalent among Egyptian children and associated risk factors. Egypt J Med Hum Genet 2011; 12(1): 69-78.
10. Taye M, Afework M, Fantaye W, Diro E, Worku A. Congenital anomalies prevalence in Addis Ababa and the Amhara region, Ethiopia: A descriptive cross-sectional study. BMC Pediatr 2019; 19(1): 234.
11. Sitkin NA, Ozgediz D, Donkor P, Farmer DL. Congenital anomalies in low- and middle-income countries: The unborn child of global surgery. World J Surg 2015; 39(1): 36-40.
12. Shalaby AM, EL-Gazzar AF. The frequency, types and risk factors of congenital anomalies in a tertiary neonatal intensive care unit (A hospital based study) Amira. Ann Neonatol J 2020; 3(1): 24-45.
13. Zahed Pasha Y, Vahedi A, Zamani M, Alizadeh-Navaei R, Zahed Pasha E. Prevalence of birth defects in Iran: A systematic review and meta-analysis. Arch Iran Med 2017; 20(6): 376-85.
14. Mohseni F, Mousavi MH, Ahmadi A, Hosseinnataj A, Marvi N, Ghazanfarpour M, et al. Examining prevalence of fetal defects and related factors in neonates born and hospitalized

in Kerman Reference Hospital : A 66-month study. Int J Pediatr 2021; 9(6): 13653-62.
15. Irani M, Khadivzadeh T, Asghari Nikah SM, Ebrahimipour H, Tara F. The prevalence of congenital anomalies in Iran: A Systematic Review and Meta-analysis [in Persian]. Iran J Obstet Gynecol Infertil 2017; 21(Suppl): 29-41.
16. Abdou MSM, Sherif AAR, Wahdan IMH, Din Ashour KSE. Pattern and risk factors of congenital anomalies in a pediatric university hospital, Alexandria, Egypt. J Egypt Public Health Assoc 2019; 94(1): 3.
17. Forci K, Alami MH, Bouaiti E, Slaoui M, Mdaghri Alaoui A, Thimou Izgua A. Prevalence of congenital malformations at the "les Orangers" maternity and reproductive health Hospital of Rabat: Descriptive study of 470 anomalies. BMC Pediatr 2020; 20(1): 272.
18. Motamadinasab M, Dastgheib SA, Golshan-Tafti M, Bahrami R, Javaheri A, Tabatabaie RS, et al. Association of TCF7L2 polymorphisms with susceptibility to gestational diabetes mellitus: A systematic review and meta-analysis. World J Peri & Neonatol 2021; 4(2): 88-103.
19. Askari M, Dadbinpour A, Ekraminasab S, Shukohifar M. Incidence and risk factors related to gestational diabetes mellitus among women in Yazd: A prospective cohort study. World J Peri & Neonatol 2022; 5(2): 65-73.
20. Farzan F, Dadbinpour A, Ekraminasab S, Fallahzadeh H, Mazaheri M. Positive predictive value of screening tests in the first and second trimester of pregnancy in the diagnosis of trisomy 21, 18, and 13 using amniocentesis. World J Peri Neonatol 2022; 5(2): 74-82.
21. Daliri S, Sayehmiri K, Asadollahi K, Rezaei N, Saroukhani D, Karimi A. Prevalence of congenital anomalies in iran: A systematic review and meta-analysis. Iran J Neonatol 2018; 9(2): 22-32.
22. Davari HA, Javanmardi Z, Hooshangi Z, Moazem E. Major congenital anomalies and associated risk factors in isfahan province, iran, 2014-2015 [in Persian]. J Isfahan Med Sch 2019; 37(513): 9-15.
23. Lookzadeh MH, Alipour MR, Vakili-Zarch A, Ekraminasab S. Prevalence of congenital heart diseases in neonates of diabetic mothers: A Cross Sectional Study in Yazd. World J Peri & Neonatol 2022; 5(1): 24-9.
24. Lookzadeh MH, Alipour MR, Vakili Zarch A, Ekraminasab S. Prevalence of hypertrophic cardiomyopathy in neonates of diabetic mothers: A six-month follow-up study. World J Peri & Neonatol 2022; 5(2): 58-64.
25. Saragard Kermani E, Nazari Z, Mehdizadeh M, Shahbazi M, Golalipour MJ. Gestational diabetes influences the expression of hypertrophic genes in left ventricle of rat's offspring. Iran J Basic Med Sci 2018; 21(5): 525-8.
26. Kamal NM, Othman N. Incidence and types of congenital anomalies in newborns in sulaimaniyah city in Iraq. Acta Med Iran 2018; 56(12): 769-76.